

Reg.No.:



VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN  
 [AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]  
 Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

**Question Paper Code: 90035**

M.E. / M.Tech. DEGREE END-SEMESTER EXAMINATIONS – FEB. 2025

First Semester

Biotechnology

P23BT103 – ADVANCED BIOPROCESS TECHNOLOGY

(Regulation 2023)

Time: Three Hours

Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels	K1 – Remembering	K3 – Applying	K5 - Evaluating
(KL)	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Define crude media and synthetic media with example.	2	K1	CO1
2.	What are the advantages of statistical optimization techniques over the one factor at a time method?	2	K3	CO1
3.	Discuss any two applications of fed batch cultivation system.	2	K2	CO2
4.	Compare and contrast between internal and external feedback systems used in chemostat.	2	K4	CO2
5.	List the factors affecting the internal mixing in fluidized-bed reactors.	2	K5	CO3
6.	Define gas holdup in airlift bioreactors and its importance.	2	K2	CO3
7.	Name the time constants for transport phenomena under regime analysis for bioreactor scale-up.	2	K2	CO4
8.	What are the different types of design estimates used in process economics of a bio-product?	2	K3	CO4
9.	Explain uncertainty analysis.	2	K4	CO5
10.	Write a note on bioprocess simulator tools.	2	K3	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.	Questions	Marks	KL	CO
11. a)	What are the advantages of statistical optimization techniques over the conventional technique? Discuss Plackett and Burman design with suitable example.	13	K5	CO1
	(OR)			
b)	A CSTR (20m <sup>3</sup> ) is operated to cultivate a bacterium with a feed substrate concentration of 37 kg/m <sup>3</sup> . The organism showed $\mu_{\max} = 0.61\text{h}^{-1}$ , $K_s = 1.3\text{kg/m}^3$ and $Y_{x/s} = 0.81\text{kg/kg}$ . i. Estimate the feed flow rate that would result in 95% conversion. ii. Calculate the maximum possible biomass productivity assuming negligible product formation and maintenance requirements.	13	K3	CO1
12. a)	Define fed batch cultivation and discuss its advantages and applications. Derive the kinetic equation for biomass, substrate and product in a fed batch cultivation at quasi-steady state.	13	K2	CO2
	(OR)			
b)	Describe the operation of a plug flow reactor and derive the steady state mass balance equation for biomass and substrate. Compare and contrast plug flow reactor with CSTR.	13	K4	CO2
13. a)	Write the advantages of airlift reactors. Explain the configuration of an airlift reactor. Discuss the gas hold up in external and internal loop airlift reactors.	13	K2	CO3
	(OR)			
b)	Discuss the design and operation of i. Fluidized bed reactor ii. Trickle bed reactor and iii. Rotating disc reactor.	13	K1	CO3
14. a)	Explain the scale up of bioreactors using rules of thumb.	13	K5	CO4
	(OR)			
b)	Narrate the different steps involved in the economic analysis of a fermentation process with an example.	13	K4	CO4
15. a)	Enumerate the simulation of the process of bio-diesel production from soybean oil,	13	K4	CO5

(OR)

- b) List the various steps involved in the preparation of flow sheet for a fermentation process with an example. 13 K4 CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.	Questions	Marks	KL	CO
16. a)	<p>i. Cephalosporin is produced in a two-stage chemostat system. The first reactor is used only for the growth of the organism and the second reactor is used only for product formation. The feed substrate concentration is 17.5g/l and the volume of individual reactor is 1m<sup>3</sup>. Given: <math>\mu_{max} = 0.23h^{-1}</math>; <math>K_s = 1.5kg/m^3</math>; <math>Y_{x/s} = 0.65kg/kg</math>; <math>Y_{p/s} = 0.77kg/kg</math>; <math>m_s = 0.032kg/kg.h</math>; <math>q_p = 0.2kg/kg.h</math>.</p> <p>Calculate; a) Cell and the substrate concentration in the feed to the second reactor. b) Overall substrate conversion. C) Final concentration of the product.</p>	8	K4	CO2
	<p>ii. A secondary metabolite is produced in a fed-batch culture with the intermittent addition of glucose solution to the culture medium. The initial culture volume at quasi-steady state is <math>V_0 = 200</math> l, and glucose-containing nutrient solution is added with a flow rate of <math>F = 25</math> l/h. Glucose concentration in the feed solution and initial cell concentration are 220 g/l and 16 g/l, respectively. The kinetic and yield coefficients of the organism are <math>\mu_m = 0.3 h^{-1}</math>, <math>K_s = 0.37</math> g/l, and <math>Y_{x/s} = 0.22</math> g dw/g glucose. (a) Determine the culture volume at <math>t = 12</math> h. b) Determine the concentration of glucose at <math>t = 12</math> h at quasi-steady state. c) Determine the concentration and total amount of cells at quasi-steady state when <math>t = 12</math> h. d) If <math>q_p = 0.03</math> g product/g cells h and <math>P_0 = 0.05</math> g/l, determine the product concentration in the vessel at <math>t = 12</math> h.</p>	7		

(OR)

- b) A chemostat is operated for sewage treatment where fluctuations in incoming substrate concentration or flow rate is expected. It is highly desired to prevent large fluctuations of residual substrates or product in the effluent stream. Discuss the controlability and stabilizability of the system. 15 K6 CO3